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AIK S. YAK ET AL

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Serial No. 09/885,701

Group Art Unit: 2651

Filed: JUNE 20, 2001

Title: DEVICE FOR RECORDING AND/OR REPRODUCING AN OPTICAL RECORD CARRIER

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A certified copy of the PCT International Application No. PCT/SG00/00088 filed June 23, 2000 and referred to in the Declaration of the above-identified application is attached herewith.

Applicants claim the benefit of the filing date of said European application.

Respectfully submitted,

By Michael E. Belk  
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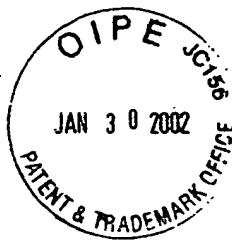
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This is to certify that the annexed is a true copy of the following PCT International application as filed in this Registry.

Date of Filing : 23 JUNE 2000

Application number : PCT/SG00/00088 (WITHDRAWN)

Applicants : (1) PHILIPS ELECTRONICS ASIA PTE LTD  
(2) KONINKLIJKE PHILIPS ELECTRONICS N.V.

Title of Invention : DEVICE FOR RECORDING AND/OR REPRODUCING AN OPTICAL RECORD CARRIER

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0	For receiving Office use only	
0-1	International Application No.	PCT/SG 00 / 000088
0-2	International Filing Date	23 JUN 2000 (23-06-00)
0-3	Name of receiving Office and "PCT International Application"	REGISTRY OF PATENTS (SINGAPORE) PCT INTERNATIONAL APPLICATION
0-4	Form - PCT/RO/101 PCT Request	
0-4-1	Prepared using	PCT-EASY Version 2.90 (updated 08.03.2000)
0-5	Petition The undersigned requests that the present international application be processed according to the Patent Cooperation Treaty	
0-6	Receiving Office (specified by the applicant)	Intellectual Property Office of Singapore (RO/SG)
0-7	Applicant's or agent's file reference	SG 00009WOP
I	Title of invention	DEVICE FOR RECORDING AND/OR REPRODUCING AN OPTICAL RECORD CARRIER
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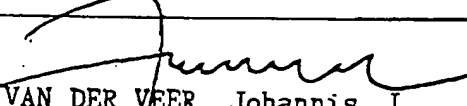
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V	Designation of States		
V-1	Regional Patent (other kinds of protection or treatment, if any, are specified between parentheses after the designation(s) concerned)	EP: AT BE CH&LI CY DE DK ES FI FR GB GR IE IT LU MC NL PT SE and any other State which is a Contracting State of the European Patent Convention and of the PCT	
V-2	National Patent (other kinds of protection or treatment, if any, are specified between parentheses after the designation(s) concerned)	SG	
V-5	Precautionary Designation Statement In addition to the designations made under items V-1, V-2 and V-3, the applicant also makes under Rule 4.9(b) all designations which would be permitted under the PCT except any designation(s) of the State(s) indicated under item V-6 below. The applicant declares that those additional designations are subject to confirmation and that any designation which is not confirmed before the expiration of 15 months from the priority date is to be regarded as withdrawn by the applicant at the expiration of that time limit.		
V-6	Exclusion(s) from precautionary designations	NONE	
VI	Priority claim	NONE	
VII-1	International Searching Authority Chosen	European Patent Office (EPO) (ISA/EP)	
VIII	Check list	number of sheets	electronic file(s) attached
VIII-1	Request	3	-
VIII-2	Description	6	-
VIII-3	Claims	2	-
VIII-4	Abstract	1	sg000009ab.txt
VIII-5	Drawings	2	-
VIII-7	TOTAL	14	

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	Accompanying items	paper document(s) attached	electronic file(s) attached
VIII-8	Fee calculation sheet	✓	-
VIII-10	Copy of general power of attorney	✓	-
VIII-16	PCT-EASY diskette	-	diskette
VIII-18	Figure of the drawings which should accompany the abstract	2	
VIII-19	Language of filing of the International application	English	
IX	Signature of applicant or agent		
IX-1	Name (LAST, First)	VAN DER VEER, Johannis, L.	
IX-2	Capacity	Authorized Representative	

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Eindhoven, April 17, 2000

  
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Device for recording and/or reproducing an optical record carrier.

The invention pertains to a device for recording and/or reproducing an optical record carrier, comprising:

an optical system for projecting a first, a second and a third optical beam at a first, a second and a third spot at the record carrier,

5 a first detection element for generating a first primary position signal which is indicative for an amount of radiation reflected by the record carrier at said first spot,

a second detection element for generating a second primary position signal which is indicative for an amount of radiation reflected by the record carrier at said second spot,

10 a third detection element for generating a third primary position signal which is indicative for an amount of radiation reflected by the record carrier at said third spot,

signal processing means for generating a plurality of secondary position signals in response to the primary position signals,

15 a selection element for selecting one of the position signals as an output signal in response to a selection signal.

Such a device is known from US 4 660 191. The known device comprises a multiplier for multiplying the second position signal with a multiplication factor. A first  
20 differential amplifier subtracts the output of the multiplier from the first position signal. A second differential amplifier subtracts the third position signal from the output of the multiplier. A selection element selects the output signal of the first differential amplifier as the radial error signal if the magnitude of the first position signal is less than the magnitude of the third position signal. The selection element selects the output signal of the second  
25 differential amplifier as the radial error signal if the magnitude of the first position signal is greater than the magnitude of the third position signal. This arrangement provides for an output signal which is a monotonous function of the position in a first range from half a track before the target track until half a track beyond the target track. The output signal is linear in a second range from a quarter of a track at both sides of the target track.

It is a purpose of the invention to provide a device having a substantially increased first and second range. According to the invention the device is characterized in that the selection signal is derived from the output signal of the selection element. The output signal representing the radial error signal is constructed by selecting substantially linear  
 5 segments of the position signals. The substantially linear segments are merged into a continuous function. As the selection signal is derived from the output signal of the multiplexer it is possible to substantially enlarge the first and the second range as is described below.

10 In a preferred embodiment at least one further position signal is obtained by adding a constant value to a position signal. This is a very efficient way to merge the substantially linear segments into a continuous function.

The selection signal may be derived from the output signal of the selection element in several ways. Preferably a lookup table is used as this enables a fast computation of the selection signal.

15

These and other aspects of the invention are described in more detail with reference to the drawing. Therein

20 Figure 1 schematically shows an embodiment of a device according to the invention,

Figure 2 shows in more detail a part of the device of Figure 1,

Figure 3 shows some signals occurring in the embodiment of Figure 1 and 2.

Figure 4 shows further signals occurring in the embodiment of Figure 1 and 2.

Figure 5 shows in more detail another part of the device of Figure 1.

25

Figure 1 shows a device 2 for recording and/or reproducing an optical record carrier 1. The device 2 comprises a read unit 3 for detecting an optical pattern at the record carrier and generating an electrical read signal in response thereto. The read signal is  
 30 equalized by an equalizer 4, in order to optimize the read signal for detection. A detector 5 generates a binary signal out of the optimized read signal. The binary signal is demodulated by a channel decoder 6. Next the output signal is obtained from the demodulated signal by an error detecting and correcting unit 7. The signal stored at the record carrier is for example protected by CIRC-encoding and subsequently modulated by a channel code as EFM.



A part of the read unit is shown in more detail in Figure 2. The read unit 3 comprises a projecting unit for projecting a first, a second and a third optical beam at a first 11, a second 12 and a third spot 13 at the record carrier 1. The record carrier 1 has tracks of which a target track T0, a preceeding track T-1 and a succeeding track T1 are shown in  
 5 Figure 2. As it is well known as such how to generate the three beams, and as this is not relevant for the present invention the projecting unit is not shown here. The read unit comprises first detection means 31.1, for generating a first primary position signal D5 which is indicative for an amount of radiation reflected by the record carrier 1 at said first spot 11. The read means comprises second detection means 31.2 for generating a second primary  
 10 position signal C which is indicative for an amount of radiation reflected by the record carrier 1 at said second spot 12. The read unit 3 further comprises third detection means 31.3 for generating a third primary position signal D1 which is indicative for an amount of radiation reflected by the record carrier 1 at said third spot 13. The read unit 3 comprises A/D  
 15 converters for converting the signals generated by the detection means 31.1, 31.2, 31.3 into a digital format.

The signals D1, C and D5 are shown as a function of the position with respect to the target track T0 in Figure 3.

The read unit 3 comprises signal processing means 34.1, 34.2, 34.3, 34.4, 35.1, 35.2, 35.3, 35.4 for generating secondary position signals S1, S2, S3, S4 in response to the  
 20 primary position signals. In the embodiment shown the secondary position signals relate to the primary position signals D5, C and D1 as follows:

$$S1 = D5 + C1,$$

$$S2 = -C + C2,$$

$$S3 = C + C3,$$

$$25 \quad S4 = D5 + C4.$$

The proper values for the constants C1, ..., C4 depend on the amplitudes of the signals D5, C and D1. Preferably these signals should have a mutually equal amplitude in order to achieve that the signal WRE is a substantially linear function of the position with respect to the target track. If the signals D5, C and D1 have an amplitude equal to 1 the said constants preferably  
 30 have the values:

$$C1 = -2\sqrt{2}, C2 = -\sqrt{2}, C3 = +\sqrt{2}, C4 = +2\sqrt{2}$$

A selection element formed by a multiplexer 36 selects one of the position signals S1, S2, D1, S3, S4 as an output signal WRE in response to a selection signal SEL.

The selection signal SEL is derived from the output signal WRE of the selection element 36. In the embodiment shown the selection signal SEL is generated from the output signal WRE by means of a look-up table 37. The output value SEL of the lookup table as a function of the value of the signal WRE at its input is shown in the following table. Therein it is also shown which of the position signals S1, S2, D1, S3, S4 is selected by the multiplexer.

Range	SEL	WRE
$WRE \leq -\frac{3}{2}\sqrt{2}$	1	S1
$-\frac{3}{2}\sqrt{2} < WRE \leq -\frac{1}{2}\sqrt{2}$	2	S2
$-\frac{1}{2}\sqrt{2} < WRE \leq +\frac{1}{2}\sqrt{2}$	3	D1
$+\frac{1}{2}\sqrt{2} < WRE \leq +\frac{3}{2}\sqrt{2}$	4	S3
$WRE > +\frac{3}{2}\sqrt{2}$	5	S4

Figure 4 shows in dashed lines the five position signals S1, S2, D1, S3 and S4, and in a solid line the output signal WRE provided by the multiplexer 36. The device according to the invention has a radial servo system 8 which uses the signal WRE to position the central spot 12 at the target track T0. The servo system 8 is shown schematically in Figure 5. The servo system 8 has a comparator for comparing the radial error signal WRE with a reference value, in this case 0. The resulting difference signal  $\delta$  serves as a control signal for a control unit 82 which provides a control signal  $S_r$  to an actuator which is mechanically coupled to an optical element (not shown) which influences the position of the three beams and therewith the position of the spots 11, 12, 13 at the record carrier 1. The optical element is for example a movable mirror or a lens.

The device according to the invention operates as follows: If the central beam is positioned within a range of  $-T/8$  to  $+T/8$  from the target track, then the signal D1 is selected as the radial error signal WRE. This signal is a substantially linear function of the deviation of the central spot 12 with respect to the target track T0. The servo mechanism 8

using the radial error signal WRE tends to reduce the radial error WRE to 0 and therewith reposition the central beam 12 at the target track T0.

By way of example it is supposed that a mechanical shock has the effect that the central spot 12 is displaced with respect to the target track T0, for example, to position 12', which is at a distance  $T/2$  of the target track T0. During this displacement the central spot will pass the intermediate position a, which is at a distance of  $T/8$  from the target track. The signal D1 then surpasses the value of  $\frac{1}{2}\sqrt{2}$ , so that the selection signal  $SEL = 4$  is generated

by the lookup table 37. As a result thereof the multiplexer 36 now selects the signal S3 as the position signal WRE. The signal S3 is substantially linear within the range  $T/8$  until  $3T/8$ .

During the said displacement of the central spot 12, the central spot 12 will also pass a further intermediate position b which is at a distance of  $3T/8$  of the target track. The signal S3 then surpasses the value  $\frac{3}{2}\sqrt{2}$ . The lookup table 37 then generates a value 5 for the signal SEL.

As a result the multiplexer 36 selects the signal S4 as the position signal. The latter signal is a substantially linear function of the position in the range of  $3T/8$  to  $5T/8$  and a monotonously

increasing function thereof until a position  $3T/4$ . If the displacement as a result of the mechanical shock is completed, the radial servo system will tend to reduce the radial error signal WRE to 0. During reduction of this displacement the central spot 12 will pass the intermediate position b again, now in the opposite direction. The signal WRE then decreases below a value  $\frac{3}{2}\sqrt{2}$ . The signal SEL provided by the lookup table 37 then assumes a value 4

and the signal S3 is selected by the multiplexer 36. Subsequently the position a is passed, so that the signal WRE decreases below a value  $\frac{1}{2}\sqrt{2}$ . The lookup table 37 then provides a signal SEL with a value 3. As a result the multiplexer 36 selects the signal D1 as the output signal WRE. The servo system 8 now reduces the error signal WRE to 0 and therewith repositions the central spot 12 at the target track T0.

It is remarked that the scope of protection of the invention is not restricted to the embodiments described herein. For example the range wherein the radial error signal is a linear function of the position may be further increased by increasing the number of position signals from which the selection element selects. Other position position signal may be used than the ones shown in the above embodiment, for example the position signal D1 may be replace by the signal -D5. The signal processing means may be in the form of dedicated hardware, but may otherwise be implemented as a programmed microprocessor, for example.

Neither is the scope of protection of the invention restricted by the reference numerals in the claims. The word 'comprising' does not exclude other parts than those mentioned in a claim.

The word 'a(n)' preceding an element does not exclude a plurality of those elements. Means forming part of the invention may both be implemented in the form of dedicated hardware or

5 in the form of a programmed general purpose processor. The invention resides in each new feature or combination of features.

## CLAIMS:

1. Device for recording and/or reproducing an optical record carrier (1),  
comprising:

an optical system for projecting a first, a second and a third optical beam at a  
first (11), a second (12) and a third spot (13) at the record carrier (1),

5 a first detection element (31.1) for generating a first primary position signal  
(D5) which is indicative for an amount of radiation reflected by the record carrier at said first  
spot (11),

a second detection element (31.2) for generating a second primary position  
signal (C) which is indicative for an amount of radiation reflected by the record carrier at said  
10 second spot (12),

a third detection element (31.3) for generating a third primary position signal  
(D1) which is indicative for an amount of radiation reflected by the record carrier at said third  
spot (13),

15 signal processing means (34.1, ...34.4; 35.1,...35.4) for generating a plurality  
of secondary position signals (S1, S2, S3, S4) in response to the primary position signals (D5,  
C, D1),

a selection element (36) for selecting one of the position signals (S1, S2, D1,  
S3, S4) as an output signal (WRE) in response to a selection signal (SEL),  
characterized in that,

20 the selection signal (SEL) is derived from the output signal (WRE) of the  
selection element (36).

2. Device according to claim 1, characterized in that, at least one secondary  
position signal is obtained by adding a constant value to a primary position signal.

25 3. Device according to claim 1, characterized by a lookuptable for deriving the  
selection signal (SEL) from the output signal (WRE).

4. Device according to claim 1, characterized by computation means for deriving the selection signal (SEL) from the output signal (WRE).

## ABSTRACT:

A device for recording and/or reproducing an optical record carrier (1), comprises an optical system for projecting a first, a second and a third optical beam at a first (11), a second (12) and a third spot (13) at the record carrier (1). The device further comprises detection elements primary position signals (D5, C, D1) which is indicative for an amount of radiation reflected by the record carrier at said thoses spots (11). The device  
5 further comprises signal processing means (34.1, ...34.4; 35.1,...35.4) for generating a plurality of secondary position signals (S1, S2, S3, S4) in response to the primary position signals (D5, C, D1). A selection element (36) selects one of the position signals (S1, S2, D1, S3, S4) as an output signal (WRE) in response to a selection signal (SEL). The selection  
10 signal (SEL) is derived from the output signal (WRE) of the selection element (36).

Fig. 2

1/2

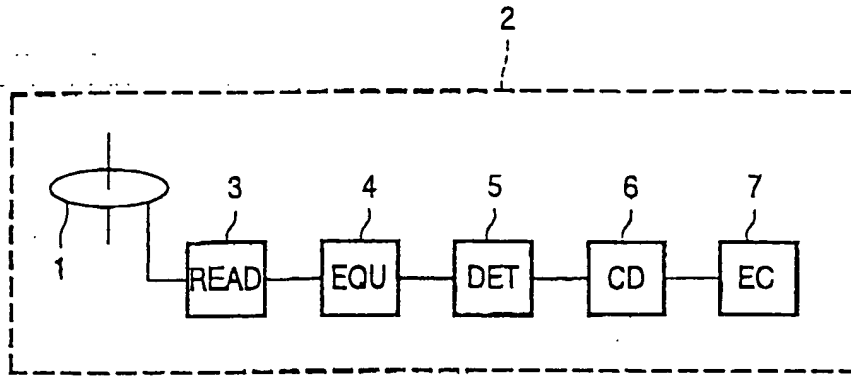


FIG. 1

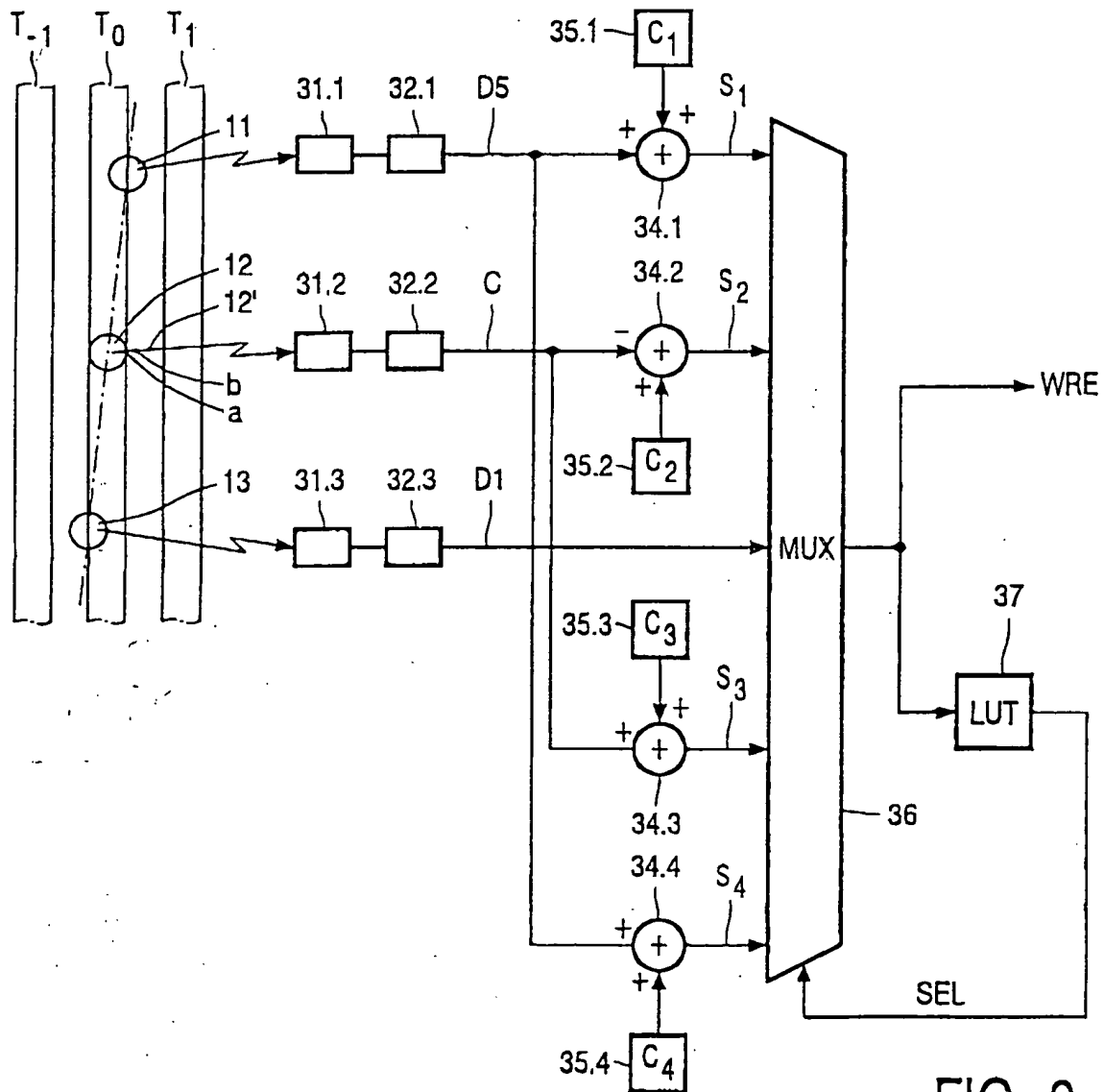


FIG. 2



2/2

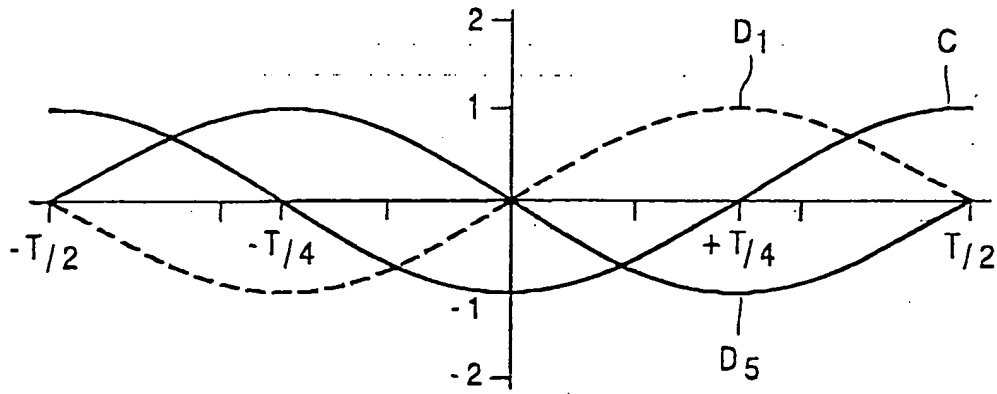


FIG. 3

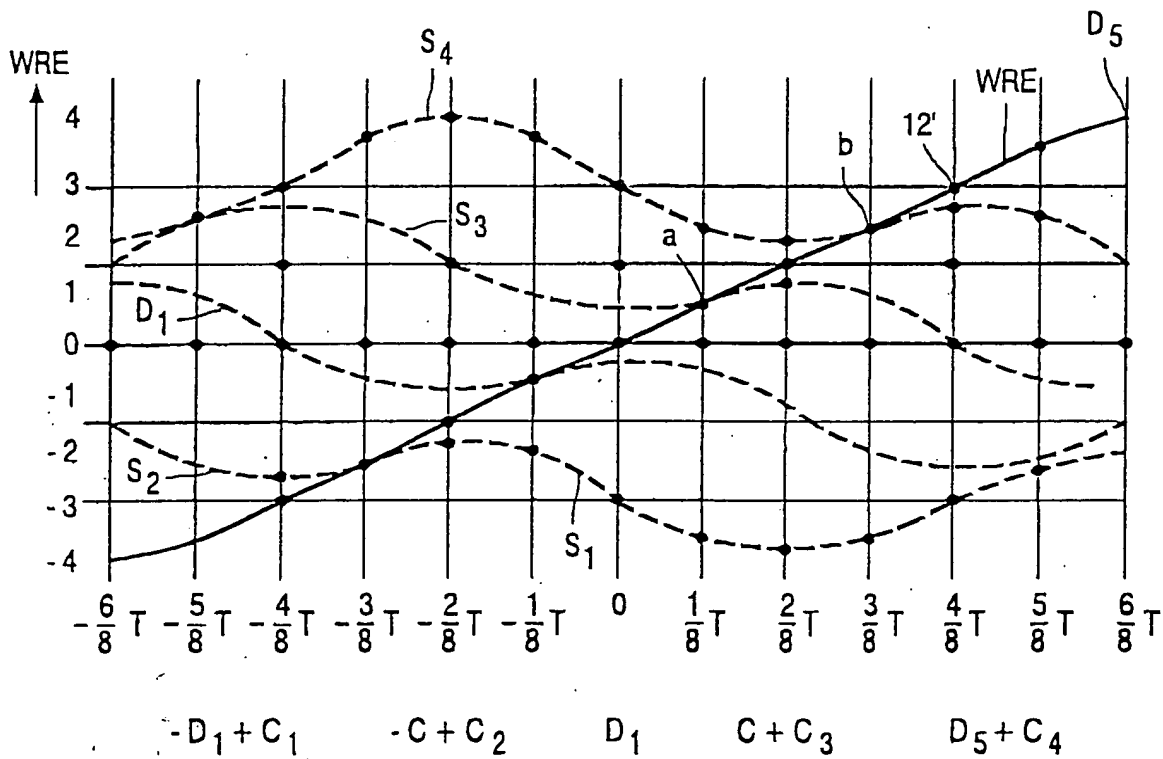


FIG. 4

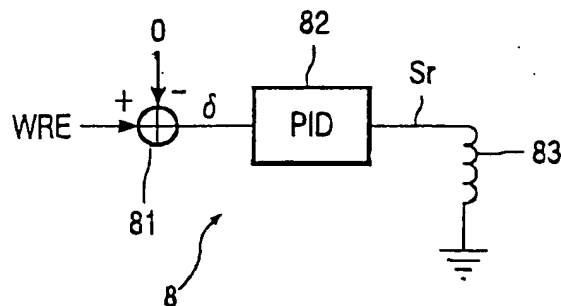


FIG. 5

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